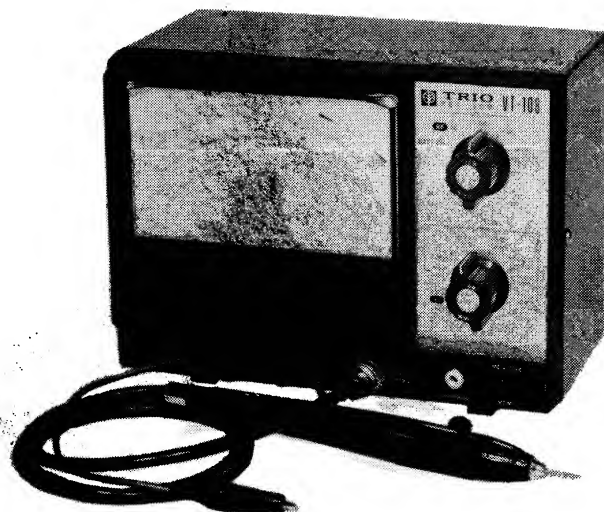




VT-108

FET VOLT-OHM METER

INSTRUCTION MANUAL



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We thank you very much for your choice of our model VT-108 FET VOLT-OHM meter.

The TRIO FET VOM VT-108 is a highly-stable P type electronic voltage-resistance meter, employing field effect transistors, provides functions for memorizing the measured voltage or resistance values.

We sincerely hope you to make the most of the VT-108 through careful operation of the set as instructed hereunder in this manual.

FEATURES

- ☐ Function provided to memorize measured values temporarily-enable user to read out measured values after completion of measurement.
- ☐ Wide range of 0.01 ~ 1,500 V for DC voltage.
- ☐ Wide frequency characteristic ranging from 20 Hz to 5 MHz for AC voltage.
- ☐ Use of adaptor enables user to operate this set from an AC 100 V (117, 230 V) source.

Switching of the set from the DC to the AC sources or vice versa may be accomplished by merely replacing a plug.

- ☐ Use of RF probe (optional item) allowed for user without replacing it with the probe attached to the set.

RATINGS

[DC VOLTMETER]

Range	:	0~0.5, 1.5, 5, 15, 50, 150, 500 and 1500 V (8 ranges)
Input resistance:	:	11 M Ω (on any of all ranges)
Input capacity	:	3 pF or less
Accuracy	:	$\pm 3\%$ of full scale
Max. input voltage	:	1500 VDC or 1500 V peak (DC + AC)
Polarity	:	+, -

[AC VOLTMETER]

Type of detection	:	P-P detection
Range	:	7 ranges

AC sine wave ... 0.1~1.5, 5, 15, 50, 150, 500 and 1500 Vrms. -15 ~ +16 dBm, as direct reading scale 26, 36, 46, 56 and 66 dBm, as measurements obtained through con- version	[Resistance meter] Range : 0.1 Ω ~ 1000 M Ω (7 ranges) Center gradua- tion : 10 Ω , 100 Ω , 1 k Ω , 10 k Ω , 100 k Ω , 1 M Ω and 10 M Ω . Voltage impress- ed : Max. 1.8 V (1.5 V average, operated from type UM-1 dry battery) Accuracy : \pm 5% of center gradu- ation reading for scale of 0.3 ~ 3 \pm 10% of center gradu- ation reading for scale of 0.1 ~ 10
Any AC wave 0.28 ~ 4.2, 14, 42, 140, 420, 1400 and 4200 Vp-p (7 ranges) Input resistance: Approx. 1 M Ω Input capacity : 145 pF or less (1.5 ~ 150 V range) 80 pF or less (500 ~ 1500 V ranges) where measured using PC-14 probe.	
Accuracy : \pm 5% of full scale Frequency char- acteristic : \pm 3% (reference of 1 kHz) 30 Hz to 2 MHz \pm 10% (reference of 1 kHz) 15 Hz to 5 MHz	[RF voltmeter] Range : As selected using the probe F, S sensitivity: Full scale for 0.455 VDC input Input resistance: 10 M Ω
Maximum input voltage : 1500 Vrms or 2000 V peak (DC + AC)	

[MEMO]

Time required
for meter to
change 1% of
indicating
angle

: 1 min. or more (30°C,
less than 70% humidity)

[POWER SUPPLY]

Voltage

: 6 V

Current

: 4 type UM-3 dry
battery
1.8 mA or less
(Approx. 1.3 mA for
indication of zero;
Approx. 1.6 mA for in-
dications of OHMS and
full scale ranges

(Operative from 100, 117 or 230 VAC
through the use of AC adaptor AD-108)

[DIMENSIONS & WEIGHT]

Dimensions

: 186 mm (190 mm) wide
131 mm (138 mm) high
105 mm (142 mm) length
Values in () includ-
ing those of all pro-
trusions.

Weight

: Approx. 2 kg (includ-
ing those of acces-
series and dry battery

[ACCESSORIES]

Instruction

manual : 1

PC - 14 probe : 1

Dry battery UM-1: 1

UM-3: 4

CIRCUIT DESCRIPTION

1. METER CIRCUIT

The meter circuit is connected through differential connection to field effect transistors (FFT) Q1 and Q2 (2SK30-0) acting as the source followers. So, it operates with extremely high input impedance to deliver an output of low impedance, thereby operating stably against variation of voltage supply and temperature.

The input voltage to this circuit reverses its polarity to + DC or - DC depending on the purpose of measurement. For this reason, a selector

switch is inserted at the output side of the circuit to reverse the polarity of the meter circuit.

The sensitivity of the meter can be adjusted through the semi-fixed resistor inserted in series with the meter for the AC, RF, -DC and + DC ranges and through the use of the control provided on the front panel for the OHMS range. In other words, the meter can be adjusted by means of the above-mentioned resistor and control so as to deflect over the full ranges of the AC, RF, -DC and + DC scales for an input of 0.455 VDC and of the OHMS scale for an input of approx. 1.5 VDC.

Adjustment VR is provided to make zero adjustment to the meter. It provides means to adjust the source resistance of source followers Q1 and Q2 to balance the output voltages of the source followers under the condition where there presents no input.

It should be noted that the meter is operated with the source followers unbalanced provided that the meter is

used as center zero meter.

2. MEMO CIRCUIT

The MEMO circuit is of the simplest type. It provides facilities to have the meter persistantly indicate the value of the voltage measured. This is based on the following theory of operation of a capacitor:

If the equivalent resistance connected in parallel with a charged capacitor offers an extremely high value, it takes a considerably long time for the capacitor to discharge its charge, thereby sustaining the voltage across it almost unchanged.

The field effect transistors used as the source followers offer an extremely high gate input resistance and, therefore, suitable to operate in the memory circuit based on the above-mentioned theory of operation of a capacitor.

3. AC VOLTAGE MEASUREMENT

The AC voltage applied from a measuring point to the probe is fed to a capacitor, which rejects the DC

component to allow only the AC component to pass through it.

The AC component thus obtained is conducted as it is to the detector circuit provided that the component is a low voltage (150 V range or lower). If the component is a high voltage (Voltages in 500 and 1500 V ranges), it is conducted to the detector circuit after being attenuated to 1/10 of the original voltage level.

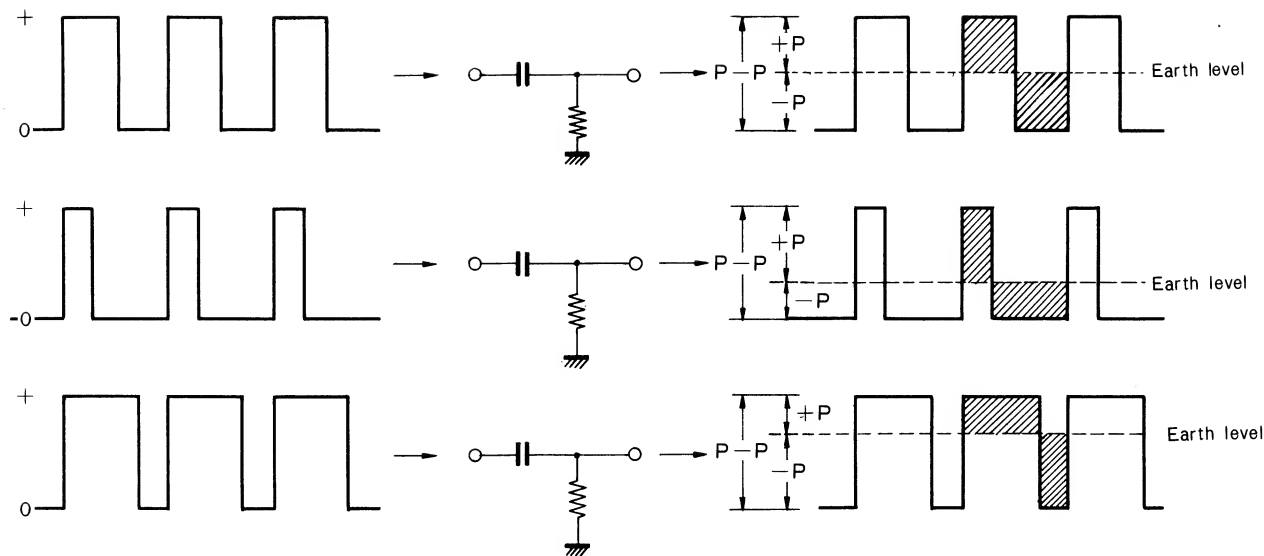
The detector circuit converts its AC input into the DC voltage through a peak-to-peak (p-p) detection. The peak-to-peak detection features the meter indication less affected by the change of voltage waveform compared with the peak detection, as illustrated in the figure (Page 6).

As seen from the figure, the meter will give the same indication to input waveforms under the peak-to-peak detection of the waveforms have the same wave height. While, the meter will give the

indication for the amplitudes of the input waveforms expressed + or - P under the peak detection and it follows that the meter will give different indications provided that the input waveforms have different wave heights. (The hatched blocks in the figure shows the same areas of the waveform in the positive and negative side against the earth level).

The DC output from the detector is conducted to a range selector attenuator is conducted to a range selector attenuator through a variable resistor where it is attenuated to the same voltage level as the DC measurement. This voltage level may be calibrated against the effective value measured on a sine wave voltage.

The DC voltage, from the variable resistor is selected by the attenuator for an appropriate range and then conducted via the MEMO circuit to the meter indicator circuit.



4. DC VOLTAGE MEASUREMENT

When this meter is set up for a DC measurement, a resistance of $1\text{ M}\Omega$ is inserted in the probe in series with the input circuit of the set. This resistor, called the capacity canceler, is used to prevent the capacities of the probe and cable from being

directly coupled to, and affecting adversely to the circuit under measurement with the resultant variation of the voltage and the oscillator frequency.

The voltage passed through the probe enters the attenuator in the main unit, where an appropriate range is selected

for the input voltage depending on the voltage under measurement. The output voltage from the attenuator is then fed through the MEMO circuit to the meter indicator circuit.

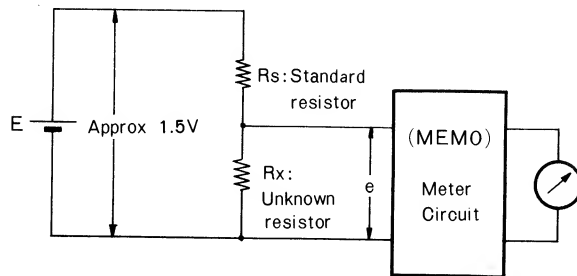
The switching of the polarities of the meter to the input voltage is accomplished by reversing the connection of the meter in the meter indicator circuit.

Semi-fixed resistors are also provided for calibrating the meter sensitivity for the + and - DC voltages, respectively.

5. RESISTANCE MEASUREMENT

The resistance measuring circuit of this meter expresses the voltage measured for a resistance having an unknown value in terms of a resistance value, as read on a resistance value scale. That is, the resistance measuring circuit is so designed that it measures the voltage developed across the resistance having an unknown value and inserted in series with the standard resistance when a DC voltage of approx. 1.5 V is applied across the standard resistance and the resistance having the unknown value,

and then expresses the measured voltage in terms of the resistance value calibrated on the resistance value scale.



$$e = \frac{R_x}{R_s + R_x} \cdot E$$

If $R_s = R_x$

$$\text{Then } e = \frac{E}{2}$$

The above means that the meter is set to the center graduation 1 of resistance value scale.

6. RF VOLTAGE MEASUREMENT

When this meter is set up for an RF voltage measurement, the RF input is directly applied through the MEMO circuit to the meter indicator circuit. Accordingly, the attenuator should be at the RF.

The above method is advantageous in such point that any probe may be used with this meter set for an RF voltage measurement provided that the output DC voltage of the probe is calibrated so that it deflects the meter over the full range of RF voltage scale when it assumes a value of 0.455 V.

OPERATING INSTRUCTION

1. PANEL CONTROLS AND THEIR FUNCTIONS

The panel controls and their functions are as given in the tables below.
Also, refer to the external views shown in Pages 34, 35.

FRONT PANEL

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
①	(PILOT LAMP)	Turns red when POWER switch ② is turned to ON to indicate that the set is in the running condition. Turns black when POWER switch ② is turned to OFF.
②	POWER	POWER switch which, when placed in position ON, turns on this set. In the left-hand position OFF, the switch not only turns off the set but also short the meter out of the meter circuit in connection with the position BATT. CH of use selector switch ⑨ to damp the meter's pointer against vibrations during transportation.
③	ZERO. ADJ	Electrical zero adjustment Set this adjustment to the point for which the meter's pointer remains unmoved when use selector switch ⑨ is placed in positions - DC and + DC

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		<p>alternately with POWER switch ② ON. (Note that the pointer moves in the opposite directions when the adjustment is operated with use selector switch ⑨ placed in the - DC and + DC positions.) If the mechanical zero differs from the electrical zero on the scale obtained as mentioned above, adjust mechanical zero adjustment screw ⑩ of the meter until the pointer is set to the zero graduation of scale. If the meter is used with the center zero graduation, set the pointer to the center zero graduation of the scale.</p>
④	OHMS. ADJ	<p>This is the full scale position (∞) adjustment for resistance measurement. Adjust this control until the pointer is set to position ∞ with the use selector switch ⑨ set at position OHMS. Turning this adjustment clockwise causes the pointer to move in the right. Note, however, that this adjustment should be adjusted only after the ZERO ADJ. ③ is adjusted properly.</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
⑤	DC AC OHMS	Terminal for connecting PC-14 probe. The measurements for AC, DC (+ DC, - DC) and resistance shall be made using the probe connected to this terminal. The outer screwed portion of this terminal, connected to the case of main unit, provides means for connecting the alligator clip of the probe to the set.
⑥	RF PROBE	Terminal for connecting RF probe. If the signal which, not to speak of that provided by the RF probe, deflects the meter over the full range of its scale when it assumes a value of 0.455 VDC is connected to this meter set, the set may be used as an indicator. In other words, this terminal serves as an independent measuring terminal when range selector switch ⑧ and use selector switch ⑨ are placed in the RF positions respectively. If range selector switch ⑧ is placed in position RF with use selector switch ⑨ placed in position OHMS as a special case, this terminal is connected in parallel with DC AC OHMS terminal ⑤ with other circuits set up for an RF voltage measurement. Note, however, that it sometimes happens that the impedance looked from DC AC

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		<p>OHMS terminal ⑤ becomes very low or high in the above usage of the terminal. For this reason, never try to use the terminal in the special use unless otherwise required consciously.</p>
⑦	MEASURE—MEMO	<p>Set this switch in position MEASURE for making a measurement. Turn the switch from position MEASURE to position MEMO during measurement and the meter holds its indication for the measured value for a while.</p> <p>Return the switch to position MEASURE whenever user intends to proceed to the next measurement or the set is placed in the stand-by connection.</p> <p>If this switch placed in the MEMO position under a resistance measurement on 10 or 100Ω range, the meter indication is slightly shifted to the right on the scale. This is due to the voltage drop developed across the dry battery for resistance measurement owing to the current which flows during measurement of resistance and, therefore, should be measured as a corrected value.</p> <p>As to details, however, refer to the paragraph for the resistance measurement.</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
⑧	(RANGE SELECTOR SWITCH)	<p>Range selector switch</p> <p>The figures marked at the positions of this switch indicate the highest voltage for the selected ranges respectively under voltage measurement. As to the resistance, the figures indicate the resistance value corresponding to the center point 1 on the scale. The range of this switch including the 0.5 V range are effective for only a DC voltage measurement. For the AC voltage and resistance measurements, the 1.5 V and 10Ω ranges or higher are used.</p> <p>When this switch is placed in the RF position, it is connected to the RF PROBE terminal provided that use.</p>
⑨	(USE SELECTOR SWITCH)	<p>1) BATT. CH. When this switch is placed in the BATT. CH. position, the meter indicates the supply voltage of the dry battery (4 UM-3) for the meter circuit. If the pointer is within the range of ► BATT ◄, it indicates the normal dry battery voltage and, therefore, suggests that the set allows the user to make a proper measurement. If the pointer is positioned to the left of the above-mentioned range, it indicates that the dry battery fail to provide the normal</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		<p>voltage and that any error may be introduced in the measured value. In such case, replace the dry battery with new, proper ones.</p> <p>It should be noted that, if POWER switch ② is turned to OFF with this use selector switch placed in the BATT. CH position mentioned above, the meter is shorted out of the meter circuit to protect the meter against shocks and vibrations. But, if an AC source adaptor (Model AD-108) (Optional item) is used with the set, this switch position has no concern with the voltage indication and serves merely to short the meter out of the meter circuit together with the POWER switch.</p> <p>2) RF. AC This switch position is provided for an AC voltage measurement. When the use selector switch is placed in this position, turn the switch on PC-14 probe in the AC position too. The switch placed in this position offers a relative large input capacity. So, any high impedance circuit should be measured with sufficient consideration given to the effect of the above-mentioned input capacity. The RF probe should be used for measurement of an RF circuit. To make an RF voltage measurement, use the RF probe with range selector switch ⑧ placed in</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		<p>the RF position.</p> <p>3) - DC, + DC These are the positions of the use selector switch for a DC voltage measurement. The switch on PC-14 probe should be placed in the DC position in this case. Selection of either - DC or + DC position depends on the voltage of the probe contactor against the alligator clip. If the voltage of the contactor is positive against the clip, then select + DC position for this switch. If the voltage is negative, then select - DC position for the switch.</p> <p>4) OHMS This is the position of the use selector switch for a resistance measurement. The switch on PC-14 probe should be placed in the Ω position in this case. When the use selector switch is in this position, the meter set allows to make simple measurement of a diode, transistor, etc. In this case, the positive voltage should be connected to the contactor of probe and the negative voltage to the alligator clip.</p>
⑩		<p>Mechanical zero adjustment screw</p> <p>This adjustment screw should be so adjusted that</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		<p>the meter deflects to zero properly with POWER switch ② placed in OFF position.</p> <p>The mechanical zero adjustment should be performed as required depending on the mounting position of this set, because the meter gives the zero points slightly shifted from each other owing to the vertical and slant positions of the set.</p>
⑪		<p>Meter cover setscrew</p> <p>Don't try to remove two meter cover setscrews in cases other than the repair of meter and etc.</p>

REAR PANEL

REF NO.	CONTROLS & CONNECTOR	DESCRIPTION
⑫		<p>Handle</p> <p>This is the handle for carrying the set. It also serves as the leg of the set when the set is placed in a slant position.</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
⑬	Plunger	If the tips of two plungers are pulled approx. 5 mm outward, the rear plate can be removed. Therefore, these plungers are used to remove the rear plate replacement of dry battery calibration and exchange of DC and AC sources.
⑭	Rubber leg	Use this rubber leg to insulate the meter set from other conductor with set placed in the vertical position when a voltage measurement is to be made while floating the battery of the set. Note, however, that the leg may be used with the meter set placed in a slant position provided that the measurement is made on an insulating material and free from such fear as short-circuit or electric shock.

INSIDE

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
⑮		<p>Dry battery (4 UM-3)</p> <p>Dry battery as power supply for meter circuit. If the pointer of the meter deflects to the left of the mark ► BATT ◄ , replace the battery. Any type of dry battery may be used only if the type of battery is UM-3.</p> <p>When loading the battery on the battery holder, insert the battery properly in accordance with the polarities shown on the holder.</p>
⑯		<p>Dry battery (UM-1) for resistance measurement</p> <p>If the meter can not be set to graduation ∞ by means of the OHMS. ADJ or the meter indication changes during the measurement with the use selector switch set at a lower OHMS range, it suggests the battery discharged and, therefore, replace the battery with a new, proper one. The top of the battery provide the positive polarity.</p>
⑰		<p>Power source selector plug</p> <p>The power source selector plug is the 9-pin plug</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		<p>used to select an AC or DC source for the meter operation. When the plug is inserted in the socket on a printed circuit board, the meter set operates from the dry batteries. If it is inserted in the socket of AD-108 adaptor, it is operative with an AC source of 100 V, 117 V or 230 V. The set may be switched to the dry battery with the AC source adaptor unremoved.</p>
⑱	- DC. ADJ.	<p>Calibrator for - DC voltage indication Operate this calibrator carefully, because the calibrator is related with the calibration of the AC and RF meter indications. Turning this calibrator counterclockwise cause the meter to increase its indication. That is, this calibrator should be turned in the same direction as that of the movement of the pointer</p>
⑲	+ DC ADJ	<p>Calibrator for + DC voltage indication The calibration of the + DC voltage indication should be conducted by this calibrator independently. Turning this calibrator counterclockwise causes the meter to increase its indication. That is, the calibrator should be turned in the same</p>

REF. NO.	CONTROLS & CONNECTOR	DESCRIPTION
		direction as that of the movement of the pointer.
20	AC ADJ	<p>Calibrator for AC voltage indication</p> <p>This adjustment should be performed after calibration of - DC. ADJ. ⑮ . It has no concern with terminal RF. PROBE. Calibration of the setting of meter for the RF signal can be made through the use of the - DC. ADJ ⑮ .</p>

2. GENERAL OPERATING PROCEDURE

Preliminary Operations

- 1) Turn the POWER switch ② to position OFF (Left-side position).
 - 2) Pull two plungers ⑬ on the upper rear plate of the set out of their positions approx. 5 mm and remove the rear plate using the handles.
 - 3) Pull the battery holder located on the inner right side out of its position, insert four type UM-3 dry batteries supplied with the set in their positions on the holder with their polarities selected properly, and replace the holder in its original position. Then, never fail to check that the snap cord is connected to its socket securely.
 - 4) Place one type UM-1 dry battery in the battery holder located at the inner center section of the main unit with its positive side positioned up-side.
- In this case, be careful not to move the calibrators provided on the printed circuit board at the upper and the lower left corner.

- 5) Replace the rear panel to the set. In doing this, make sure that the bottom edge of the plate engages securely with the leg of main unit. Push the plungers and they are fixed in their positions.
- 6) Attach the PC-14 probe to the set.
- 7) With the POWER switch ② set at position OFF, check that the meter is set to its zero position and make zero adjustment of the meter if necessary.
- 8) Turn the MEMO switch ⑦ to position MEASURE.
- 9) Turn the range selection switch ⑧ to position 1500 V.
- 10) Turn the POWER switch ② to position ON.
- 11) Set the use selection switch ⑨ to position BATT. CH. and check that the pointer of meter deflects to within the range of ► BATT ◀ .
- 12) With the use selection switch ⑨ set to position + DC, operate the ZERO. ADJ. ③ until the meter is set to graduation 0.
- 13) Then, turn the use selection switch ⑨ to position -DC. If the pointer

moves a little, adjust the ZERO. ADJ. so that the meter is set to graduation 0. (The pointer moves in the opposite direction when the switch is placed in the - DC position)

- 14) Repeat the steps 12) and 13) until the pointer of meter is left standstill.
- 15) With the use selection switch ⑨ set at position OHMS, adjust the OHMS. ADJ. control ④ until the meter is set to position ∞ . The above makes the set ready for measurement. Then, proceed to measurements in accordance with the procedures given in this manual.

APPLICATIONS

1. AC VOLTAGE MEASUREMENT (RMS, P-P, dBm)
 - 1) Perform steps 7) - 14) given under the preliminary operations (Page 20).
 - 2) Set the use selector switch to position RF AC.

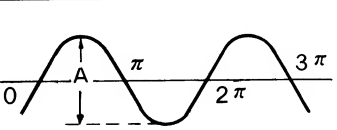
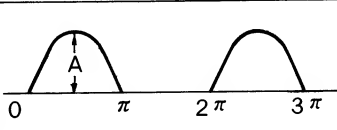
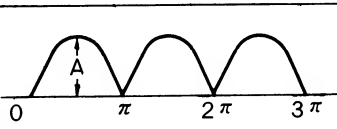
- 3) Turn the switch on PC-14 probe to position AC, Ω .
- 4) Attach the clip of PC-14 probe to chassis or minus side of the equipment under measurement. (Attach the clip to the point having the possible lowest potential when a voltage measurement is to be made between the points floated above the earth.)
- 5) Bring the contactor of the probe to the measuring point.
- 6) Slowly switch the range selector switch ⑧ down over its positions starting at the 1500 V range position until the meter deflect to $1/3$ of its scale or its right side and then read the meter.
- 7) With the MEMO switch set to the MEMO position as required, remove the contactor of probe from the measuring point and read the meter indication. Then, turn the switch to the MEASURE position.

[CAUTIONS ON MAKING MEASUREMENT]

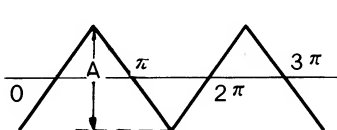
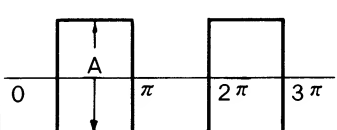
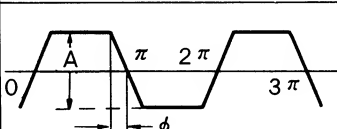
- 1) Connection of the present meter set including the probe to the

circuit to be measured inserts a resistance component of approx. $1\text{ M}\Omega$ and a capacity of approx. 150 pF (Refer to the paragraph for Ratings) in the measuring circuit. For this reason, it sometimes happens that the voltage actually measured is subjected to a change and the oscillator and tuning circuits changes their frequencies and output voltages when the meter set is used for measurement of a high impedance circuit. When making measurement of the high impedance circuit, never fail to take the above fact into consideration. (In such case, use the RF probe).

- 2) The relation of the effective voltages to the wave heights of the so-called AC voltages differs depending on the waveforms of the AC voltages. So, users are requested to make voltage measurements with sufficient care. The present meter set indicates the peak-to-peak (p-p) value of a voltage waveform. Therefore, calculate the effective value from the peak-to-peak value obtained. An example of waveforms is shown in the preceeding page.

Waveform	Effective Value (r m s)
	$\frac{A}{2\sqrt{2}} = 0.354A$
	$\frac{A}{2} = 0.5A$
	$\frac{A}{\sqrt{2}} = 0.707A$

- 3) The present meter set can't provide facilities for making measurement of a voltage of less than 0.1 V because of the detection characteristics of silicon diodes employed. For this reason, the set is provided with independent

Waveform	Effective Value (r m s)
	$\frac{A}{2\sqrt{3}} = 0.288A$
	$\frac{A}{2}$
	$\frac{A}{2} \sqrt{1 - \frac{4\phi}{2\pi}}$

- scales for the 1.5 and 5 VAC ranges.
- 4) The p-p scale is calibrated for 15 and 50V range only. While, the dBm scale is calibrated for 1.5 and 5 V ranges only. Therefore, the desired values may

be obtained by referring the readings on the p-p and dBm scale to the values of RMS scale provided on the scales at the upper side.

Note, however, that

$$0 \text{ dBm} = 1 \text{ mW} (600\Omega)$$

$$0 \text{ dBm} = \sqrt{1 \text{ mW} \cdot 600\Omega} = 0.7754 \text{ V}$$

It should also be noted that the range is switched in 10 dB step. This is advantageous to make easy calculation of the measured values.

Voltage to be measured dB	Range	Add dB
+ 7 dBm	1.5V	0 dBm
+16 dBm	5V	0 dBm
+26 dBm	15V	20 dBm
+36 dBm	50V	20 dBm
+46 dBm	150V	40 dBm
+56 dBm	500V	40 dBm
+66 dBm	1500V	60 dBm

2. DC VOLTAGE MEASUREMENT

- 1) Perform step 7) - 14) given under paragraph Preliminary Operations (Page 20).
- 2) Set the use selector switch ⑨ to the + DC and - DC positions depending on the polarity of the voltage to be measured.
- 3) Turn the switch on PC-14 probe to position DC.
- 4) Attach the clip of PC-14 probe to the chassis or lower potential point of the equipment under measurement.
- 5) Bring the contactor or probe to the measuring point.
- 6) Slowly turn the range selector switch down over its positions starting at the 1500 V range until the meter deflects to 1/3 or more of the scale. Then, read the meter indication.
- 7) Turn the MEMO-MEASURE switch to position MEMO if required. Remove the contactor or probe from the measuring point and then read

the meter indication. Restore the switch to position MEASURE.

[CAUTIONS ON MAKING MEASUREMENT]

- 1) Read all meter indications on the RMS scale for the DC voltage measurement.
- 2) Use the PC-14 probe for the DC measurement and the probe offers an input resistance of 11 M Ω and an input capacity of less than 3 pF.
- 3) When the voltage under measurement varies from the positive to the negative or vice versa, it is convenient to operate the meter with the pointer set at the center of scale. Set the use selector switch ⑨ at position + DC in the above case.

3. MEASUREMENT OF RESISTANCE VALUE

- 1) Perform steps 7) - 15) given under paragraph Preliminary Operations (Page 20).
- 2) Turn the switch on PC-14 probe to position AC, Ω .

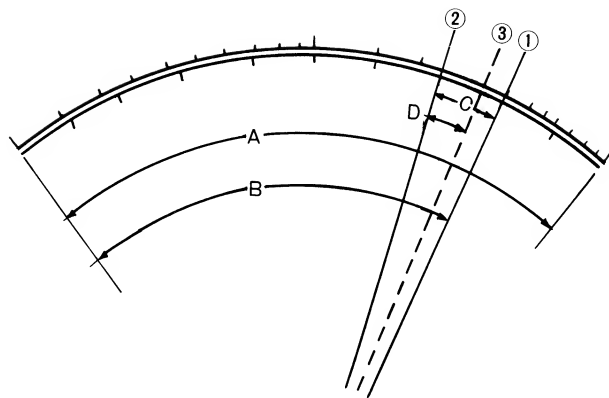
- 3) Attach the clip of PC-14 probe to one end of the resistor element to be measured and the contactor to the other end.
- 4) Slowly turn the range selector switch down over its positions starting with the 10 M Ω position until the meter deflects to around the mid-point of the scale. Then, read the meter indication.
- 5) Set the MEMO-MEASURE switch to the MEMO position as required and remove the contactor of probe from the resistor element under measurement. Then, restore the switch to the MEASURE position.

[CAUTIONS ON MAKING MEASUREMENT]

- 1) Make a resistance measurement of the resistor element to be measured with at least one end of the element cleared completely, because a resistance measurement made on the resistor element held by the hands at its both ends or placed on a conducting material.
- 2) With the MEMO-MEASURE switch set

at positions 10Ω and 100Ω , remove the probe from the resistor element under measurement and the meter slightly shifts its indication to the right. This is because the voltage drop of the batteries for resistance measurement caused by a relatively large current (Approx. 75 mA for a resistance of 10Ω provided that the meter gives its indication on the scale set to the center graduation.) drawn during the measurement and removed when the probe is disconnected from the element under measurement. In this case, convert the obtained value to the proper value as follows:

- a) First, put the meter indication on record.
- b) Bring the clip and contactor of the probe into contact under the above condition and put the shift of pointer on record.
- c) Divide the amount of the above shift by the ratio of the setting of the shifted pointer to the entire scale range and the quotient gives the proper value.



- ① Setting of pointer obtained with the MEMO-MEASURE switch set at position MEMO
- ② Setting of pointer obtained with the resistance element is shorted by the probe.
- ③ Value converted (i.e. the value obtained with the MEMO-MEASURE switch placed in position MEASURE)

$$\frac{B}{A} = \frac{D}{C}$$

or

$$\textcircled{2} + \left\{ \frac{B}{A} \times (\textcircled{1} - \textcircled{2}) \right\} = \textcircled{3}$$

When the present meter set is used for measurement of ultra-high resistance (More than 100 MΩ), operate the set from an external DC power source and convert the obtained value to the proper value in accordance with the fact that the set an input resistance of 11 MΩ for its DC range.

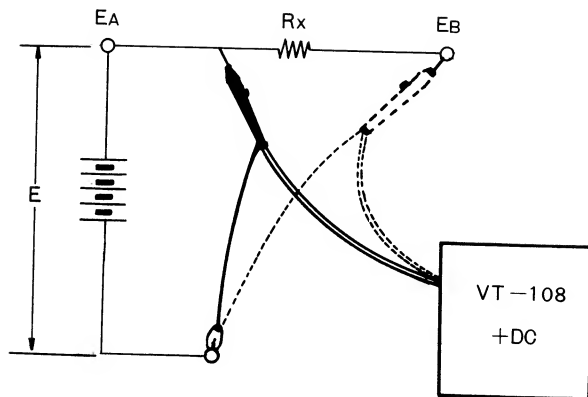
$$R_x = 11 \times \left(\frac{E_A}{E_B} - 1 \right) (M\Omega)$$

Example

Suppose that the battery of 9 V rated voltage is used as an external DC source and E_A is 9 V. Now, assume that the meter indicates 0.2 V as E_B and

$$R_x = 11 \times \left(\frac{9 \text{ V}}{0.2 \text{ V}} - 1 \right) M\Omega$$

$$= 11 (45-1) = 484 M\Omega.$$



MAINTENANCE

1. How to remove rear plate

- 1) Pull 2 plangers approx. 5 mm out of their positions.
 - 2) Pull the rear plate forward out of its position using the handleless while slightly lifting up the front end and the rear panel comes off from the set.
- To mount the rear plate, follow the above steps reversely.
- In doing the above steps, engage the bottom of the plate with the rubber legs.

2. Replacement of battery

[UM - 1]

- 1) Remove the rear panel.
- 2) Draw type UM-1 battery out of its position at the center within the set.
- 3) Place a new battery in the position for the old one with the mark \oplus of battery positioned at the up side.

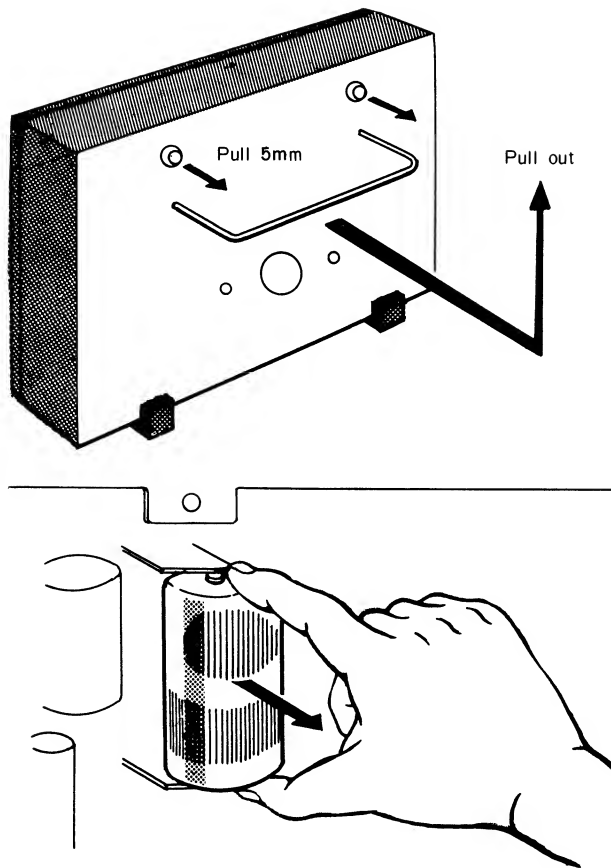
[CAUTION]

Be careful not to move calibration controls + DC, - DC and AC ADJ.

[UM - 3]

- 1) Remove the rear plate.
- 2) Draw the battery holder located in the set at the right side out of its position toward you.
- 3) Remove type four UM-3 dry batteries.
- 4) Place new batteries in accordance with the mounting instructions
- 5) Place the holder in the original position.

When doing this, engage the metal



fittings in the cut of the holder securely.

- 6) Check that the snap cord is attached to the holder securely.

3. How to remove case

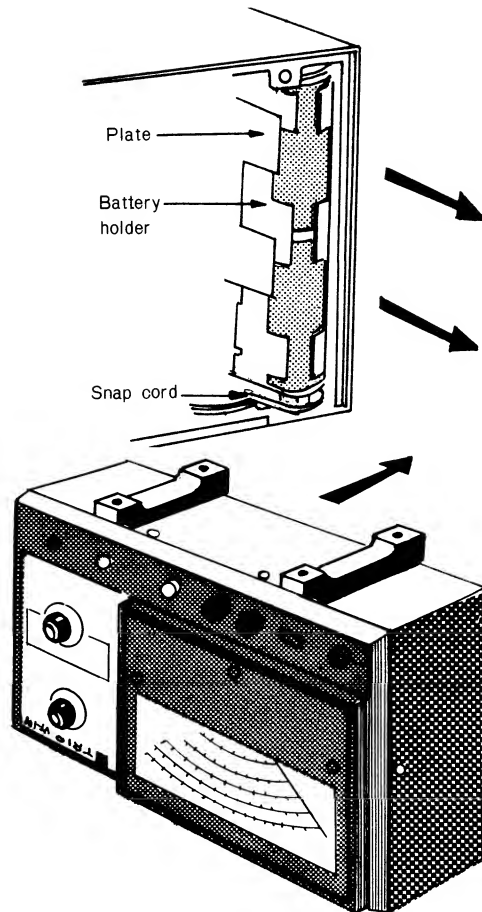
- 1) Remove 4 screws on the side and bottom of the set.
- 2) Slowly take out the case backward until it is removed from the chassis.

[CAUTION]

If the set is operated from an AC source, remove the 9-p plug succeeding to removal of the rear panel.

4. How to Remove Panel

- 1) Remove the use selector, range selector, ZERO ADJ. and OHMS ADJ knobs respectively.
- 2) Pull the plug of PC-14 probe out of its position.
- 3) Remove the nut holding the use selector switch and the panel in position.
- 4) Remove the case.



- 5) Remove one flat screw at the upper center of a mould panel.
- 6) Holding the panel and chassis together, slowly remove the panel.

ADJUSTMENT

1. - DC. ADJ.

- 1) Make mechanical zero adjustment.
- 2) With POWER switch turned ON, adjust the set for electrical zero adjustment.
- 3) Allow about 10 minutes for the set to stabilize its operation.
- 4) Set up the set for - DC voltage measurement.
- 5) Apply an accurate DC voltage (-) via the PC-14 probe to the set in such manner that the meter deflects as close to the graduation of the full scale as possible. (It is desirable to make this adjustment using 0.5 VDC)
- 6) Remove the rear plate.
- 7) Adjust the - DC ADJ. on the printed circuit board until the pointer is set to the full scale correctly.

- 8) Check the meter indications for other ranges and further make adjustment if necessary.

2. + DC. ADJ.

Apply the + DC voltage to the set, and adjust + DC ADJ on the printed board circuit in the same manner as described under the adjustment of the - DC. ADJ.

3. AC. ADJ.

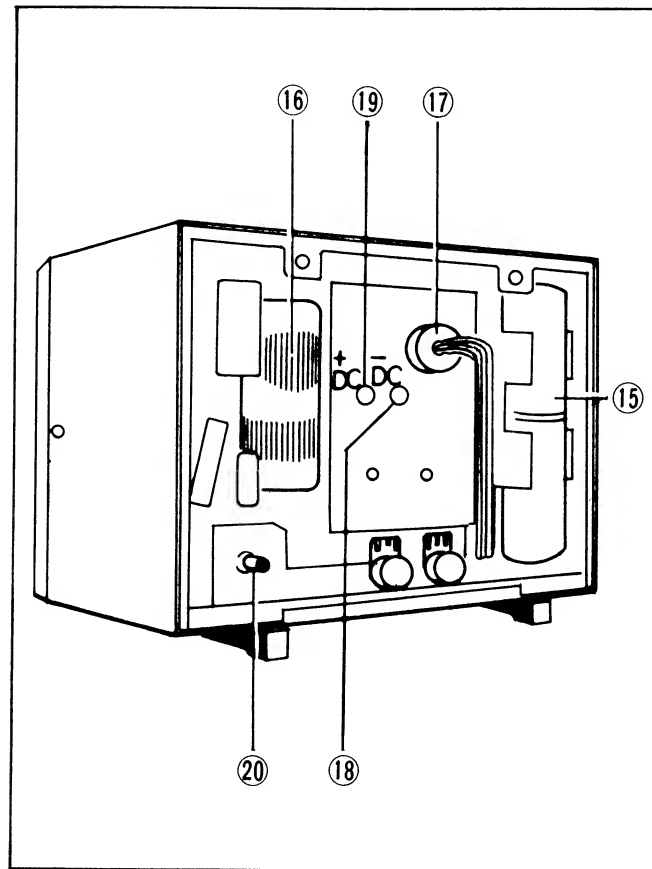
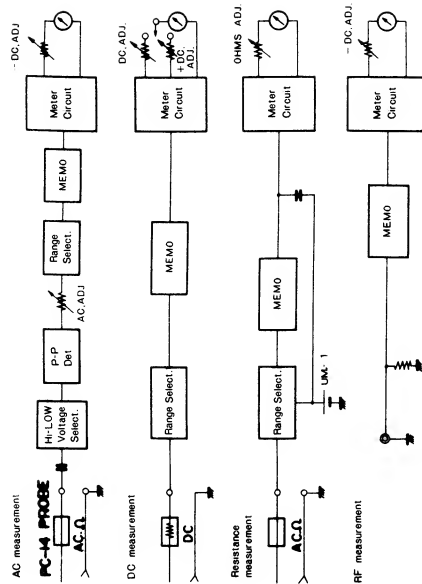
Perform this adjustment after proper adjustment of the - DC. ADJ.

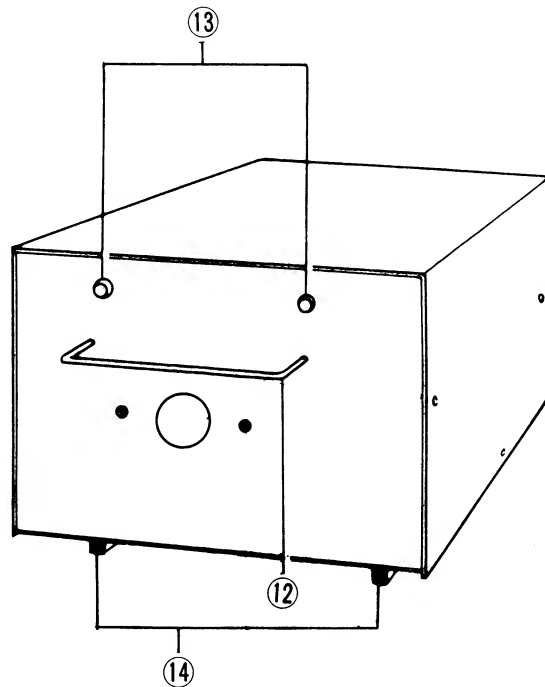
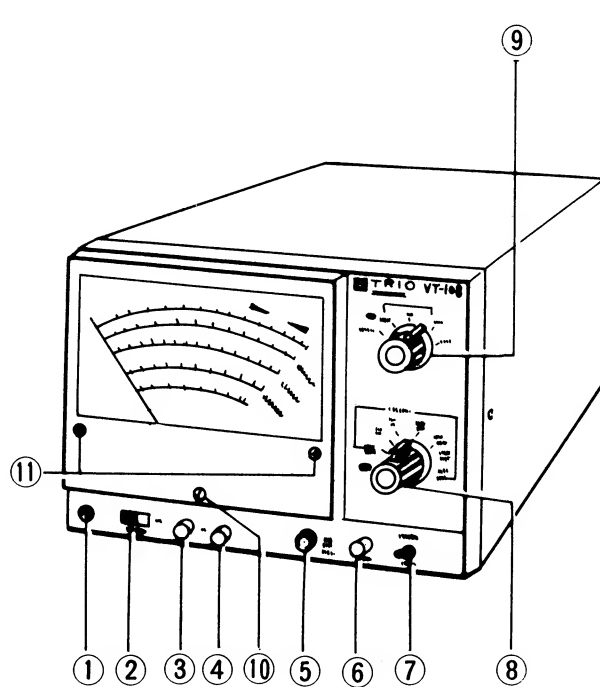
- 1) Set up the set for AC measurement.
- 2) Apply approx. 1 kHz signal having proper sine waveform and correct known voltage to the probe.
- 3) Select the range for which the meter deflects as close to the graduation of the full scale as possible.
- 4) Adjust the AC. ADJ until the pointer is set to the graduation of a given voltage.
- 5) Check the meter indications for other ranges and further make adjustment if necessary.

CAUTION ON HANDLING THE SET

- 1) Select a place not exposed to direct sunbeam as the operating place. Otherwise the internal temperature of the set is raised extremely to result in causes for an unstable operation or any damage.
- 2) Refrain from operating this set in a place where high temperature and humidity prevail. Because of the high impedance circuit employed lowered insulation due to humidity turns into a cause for indication error and shortened memory time.
- 3) Do not operate the set in a place where vibrations prevail specifically or where the set is installed near the equipment which generates strong lines of magnetic force or impulse voltages. Otherwise, it sometimes happens that FET and meter may suffer from a damage.
- 4) When measuring the voltage floated above the earth, (For instance, measurement of AC 100 V voltage), pay special attention to the insulation of the set lest the user should be subjected to an electric shock or short circuit.
- 5) To transport this set, turn the POWER switch ② to OFF with the use selector switch ⑨ to set at position BATT. CH in order to protect the meter.
- 6) When the memory circuit is used for the resistance measurement with the range selector switch set at 10 Ω or 100 Ω range, make necessary conversion of the value obtained. (Refer to paragraph for MEASUREMENT OF RESISTANCE VALUE P.25).
- 7) If the rear plate is opened during replacement of the batteries and others, be careful not to move the calibration control.
- 8) Be careful not to subject the set to sudden variation of the temperature. Otherwise water drops may be produced within the set and may result in introduction of

an error to the value obtained.
If the set is once placed in the
above condition, leave it as it is
for many hours and the set is
recovered to normal.





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